EV High Voltage Training Notes/Links
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EV Suggested Tasks List

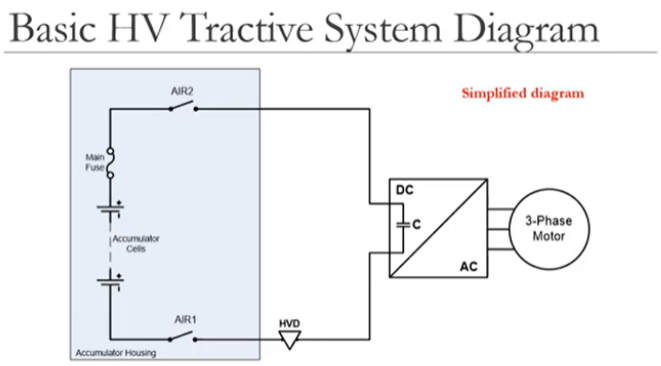
Task 1: Redesign, modify, or create an accumulator enclosure to house the HV AIRS (Accumulator Isolation Relays) and a Pre-charge relay. All three(3) relays will be the same exact type and power rating. At present, these items are located on the chassis and that is not allowed.

Task 2: Make sure all HV connectors/lugs have proper insulated covers on them. Red = B+, Black = B-

GOLDEN RULE for Accumulator Components:

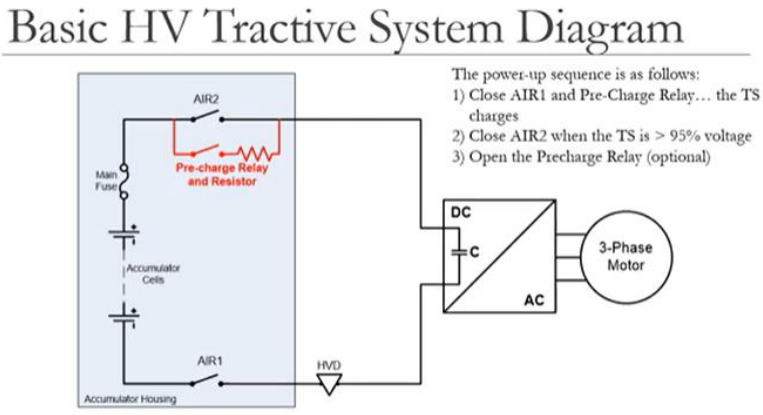
THERE MUST BE NO -UNSWITCHED HV OUTSIDE OF THE ACCUMULATOR HOUSING.

a. All HV must be switched either by the AIRs (Accumulator Isolation Relays) or Pre-charge Relay.



b. The Pre-charge Relay and AIRS may only close if all elements of the shutdown circuit are healthy.

c. The pre-charge resistor CAN be outside the Accumulator housing as long as the pre-charge relay is inside.



EV.6.4 Accumulator Isolation Relays - AIR

EV.6.4.1 Every Accumulator Container must contain minimum one fuse (**EV.7.6**) and two or more Accumulator Isolation Relays (AIR)

EV.6.4.2 The Accumulator Isolation Relays must:

a. Be a Normally Open type

b. Open both poles of the Accumulator

EV.6.4.3 When the AIRs are open, High Voltage **EV.1.1** must not be present outside of the Accumulator Container.

EV.6.4.4 The fuse protecting the Accumulator Tractive System circuit must have a rating lower than the maximum switch off current of the Accumulator Isolation Relays.

EV.6.4.5 The Accumulator Isolation Relays and any fuses must be separated from the rest of the Accumulator with an electrically insulated and Nonflammable Material (**F.1.18**).

EV.6.4.6 A capacitor may be used to hold the AIRs closed for up to 250 ms after the Shutdown Circuit is opened **EV.8.2.2**

Task 3: EV.6.5, EV.6.5.1: Determine the mounting locations for the HVD (High Voltage Disconnect) and emergency stop buttons & verify they are rules compliant. Mount them in the proper location.

EV4.7 HV Disconnect (HVD)

EV4.7.1 It must be possible to disconnect at least one pole of the tractive system accumulator by quickly removing an unobstructed and directly accessible element, fuse or connector, in case of (a) stuck accumulator isolation relay(s) for example. It must be possible to disconnect the HVD without removing any bodywork. The HVD must be above 350mm from the ground and easily visible when standing behind the vehicle. Remote actuation of the HVD through a long handle, rope or wire is not acceptable.

a. EV4.7.2 An untrained person must be able to remove the HVD within 10 seconds in ready-to-race condition. This will be tested during Electrical Tech Inspection. Being able to quickly disconnect the accumulator(s) from the rest of the tractive system by its connector(s) will satisfy this rule.
b. EV4.7.3 EV4.5 remains valid, therefore a dummy connector or similar may be needed to restore the system's isolation.

c. EV4.7.4 The HV Disconnect must be clearly marked with "HVD".
d. EV4.7.5 No tools must be needed to open the HVD. Therefore, an interlock must activate the shutdown circuit and open the AIRs when the HVD is removed.

Task 4: Perform a trade study to determine best AIR contactors to purchase. Normally OPEN. Qty = 3.

HIGHLY RECOMMENDED TO USE AIRS WITH AUXILLARY MONITORING CONTACT FOR USE BY TSAL CIRCUIT.
Look up "SAFETY RELAYS"

Task 5: Watch this video that shows dangers of using knife switches with HV DC. Disconnecting AC Vs DC with a knife switch (49) AC versus DC load breaking comparison with a knife switch - YouTube

Task 6: Evaluate Fluke Insulation tester (Megohmeter) for purchase to make sure car has no HV leaks to chassis. There are several vendors. All EV test equipment MUST be Cat 3 rated. This includes DMMs. This instrument must be used before anyone touches the car.

Task 7: Watch short HV safety video

Task 8: Watch video on HV disconnect procedure on EV/Hybrid

Task 9: Watch video on "Live | Dead | Live Test" on Chevy

Task 10: Evaluate comments/findings from SoCal Shoot out and make recommendations to improve car's current configuration.

Task 11: Find all information concerning current motors and controllers so we can make recommendations going forward. Pre-charge system requires we know exactly what capacitors are located inside motor controllers and the total capacitance of each controller.

Task 12: Research and verify the current location and wiring of HV cables are rules compliant. Make recommendations for improving protective covers

for all exposed HV cables. Make recommendations for re-routing HV cables connected to inverters.

Electronics Team Tasks

Task 1: Watch video on pre-charge/discharge pitfalls and judges feedback.

Task 2: Watch video on Shutdown circuits.

Task 3: Watch video on Brake Plausibility Device.

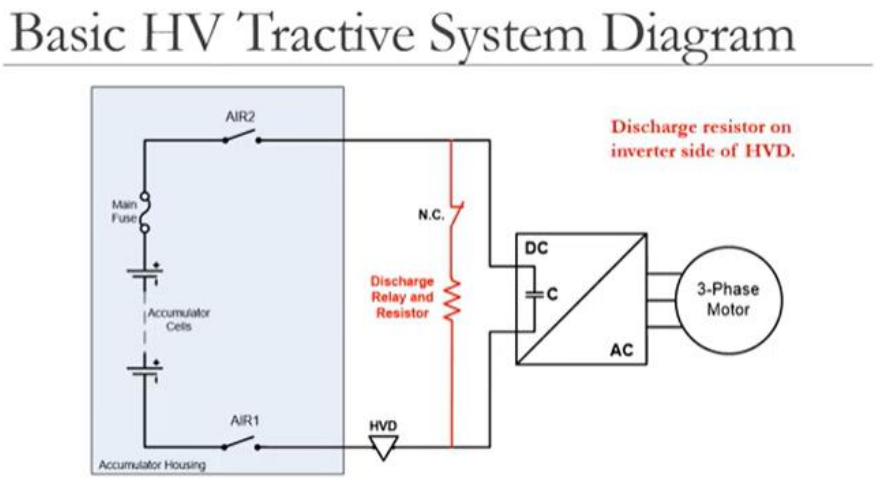
Task 4: Watch video on APPS and Safety Critical Signal Processing.

Task 5: Re-design Pre-charge circuit to be rules compliant. Begin design of wire harness diagram for pre-charge components and identify installation location.

Task 6: Determine location of Discharge relay and discharge resistor.

EV4.9 If a discharge circuit is required to meet EV6.1.5, it must be designed to handle the maximum TS voltage Permanently.

a. **The discharge resistor and relay must be located on the inverter side of the HVD (High voltage disconnect).**
b. **The discharge relay (Normally-Closed) must remain with the car when the HV battery is removed.**



Task 7: Begin a wiring diagram design for 12V DC control harness to manage AIRS and pre-charge.

Task 8: Determine appropriate location for 12V LV battery, fuse holder, and battery hold down. Create quick release wire harness for battery so accessories/components can be connected easily.

Task 9: Determine location of 12V battery ON/OFF switch and install.

Task 10: Assign someone the job of making sure 12V batteries are always charged weekly so they can be ready for testing the car at any time.

Task 11: Build a fuse and connector for a second 12V battery the team can use for bench testing our circuits.